Nonequilibrium Concentration Fluctuations in a Polymer Solution Subjected to a Stationary Temperature Gradient*

W B. Li, K.J. Zhang, J.V. Sengers, and R.W. Gammon
Institute for Physical Science and Technology
and
Department of Chemical Engineering
University of Maryland
College Park, MD 20742 USA

We have investigated nonequilibrium concentrations in a polymer solution by performing small-angle Rayleigh scattering experiments with the solution subjected to a stationary temperature gradient in a quiescent state without convection. The temperature gradient induces a concentration gradient whose magnitude is determined by the Soret effect. This concentration gradient causes a significant enhancement of the concentration fluctuations perpendicular to the temperature gradient due to a coupling of these concentration fluctuations with the transverse momentum fluctuations in the direction of the temperature gradient. The amplitude of the nonequilibrium fluctuations is proportional to the square of the concentration gradient and, hence, to the square of the temperature gradient and the square of the Soret coefficient, which has been measured with an optical beam bending technique [K.J. Zhang *et al.*, *J. Chem. Phys.* **104**, 6881 (1996)]. Moreover, the nonequilibrium concentration fluctuations become long range as they diverge with the fourth power of the wavelength of the fluctuations. A qualitative description of these nonequilibrium fluctuations has been developed for dilute polymer solutions. To interpret the experimental results at higher concentrations further development of the theory will be needed.

*Research supported by NSF Grant DMR-9215128.